Experimental and Analytical Technologies for Additive Manufacturing

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Agency:
National Aeronautics and Space Administration

Release Date:
November 14, 2014
Branch:
n/a

Open Date:
November 14, 2014
Program / Phase / Year:
STTR / Phase I / 2015

Application Due Date:
n/a
Solicitation:
2015 STTR

Close Date:
January 28, 2015
Topic Number:
T12.04

Description:

Lead Center:MSFC
Participating Center(s):JSC,LaRC,GRC,ARC

Additive manufacturing is becoming a leading method for reducing costs, increasing quality, and shortening schedules for production of innovative parts and component that were previously not possible using more traditional methods of manufacturing. In the past decade, methods such as selective laser melting (SLM) have emerged as the leading paradigm for additive manufacturing (AM) of metallic components, promising very rapid, cost-effective, and on-demand production of monolithic, lightweight, and arbitrarily intricate parts directly from a CAD file. In the push to commercialize the SLM technology, however, the modeling of the AM process and physical properties of the resulting artifact were paid little attention. As a result, commercially available systems are based largely on hand-tuned parameters determined by trial and error for a limited set of metal powders. The system operation is far from optimal or efficient, and the uncertainty in the performance of the produced component is too large. This, in turn, necessitates a long and costly certification process, especially in a highly risk-aware community such as aerospace.

State of the Art

This topic seeks technologies that close critical gaps between SOA and needed technology in both

experimental and analytical areas in materials design, process modeling and material behavior prediction to reduce time and cost for materials development and process qualification for SLM.

What is the compelling need for this Subtopic?

Additive manufacturing is largely an emerging technology that shows great promise for the defense, energy, aerospace, medical and commercial sectors. Technological advancements are needed in the areas of:

- Real-time additive manufacturing process monitoring for real-time material quality assurance prediction.
- Reduced-order physics models for individual phases of additive manufacturing technique.
- Analytical tools to understand effects of process variables on materials evolution.
- Digital models to standardize the use of structured light scanning or equivalent within manufacturing processes.
- Software for high-fidelity simulation of various SLM phases for guiding the development, and enabling the subsequent verification.

The technology enabling to further utilization and certification for aerospace components. Almost all NASA Centers have capability in additive manufacturing and will benefit from this technology. This technology will accelerate growth in commercial development.

STMD/NASA/NARP/National - The subtopic is highly consistent with the technology objectives within the Strategic Space Technology Investment Plan and the NASA’s technology roadmaps. The subtopic is also closely aligned with the National Manufacturing Initiative and the Materials Genome Initiative.